Biochar: the countryside combats climate change

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Biochar is a form of charcoal made from heating agricultural and forestry refuse and scrub and dying trees (biomass) in the absence of or with limited air. About half the carbon in the biomass is turned into biochar, which is almost all carbon, the other half being emitted as gaseous byproducts – H2O, CO2, hydrogen, carbon monoxide (CO), and other carbon compounds. The hydrogen, CO, and other carbon compounds can be burned with minimal pollution, the heat being sufficient to continue the reaction. In more advanced use a portion of the byproducts can be converted into liquid fuels or intermediates for such things as plastics and pharmaceuticals.

Biochar was known to the ancients, but it has been rediscovered in our time of climate change as a way to remove CO2 from the atmosphere. This has biochar researchers excited about its prospects in helping solve our climate problem. Besides this benefit, biochar, like compost, is a soil additive that also enhances crop and tree growth. The difference between these two soil additives is that biochar is inert to oxidation over hundreds of years, hence does not go back into the atmosphere as CO2. However, compost as well as other forms of carbonaceous material (fallen leaves and twigs and decomposing trees) emit most of their material as CO2 and other greenhouse gases to the atmosphere over five years to decades depending on climatic conditions. In some forests the yearly CO2 released to the atmosphere by decomposition of carbonaceous materials is greater than the yearly CO2 absorbed by those forests via the photosynthesis that produced new tree growth. In these forests converting the decomposing materials into biochar obviously makes environmental sense.

Biochar particles have large surface areas that both absorb nutrients and promote growth of bacteria or fungi resulting in vastly improved crop growth. Experimenters in academia and the field, in this country and abroad, have demonstrated enhanced agricultural yield, sometimes by several hundred percent. Biochar is not a substitute for compost; rather, it is used in conjunction with compost, and less compost is needed when biochar is simultaneously added to the soil.

Besides the direct effects of CO2 reduction and agricultural/forestry growth enhancement, there are the following beneficial ecological and economic secondary effects:

- Up to a 50% decrease in fertilizer needed in agriculture. Since fertilizer takes energy and money to make, and since making it emits CO2, biochar in agriculture lessens energy use, saves money, and lowers CO2 emissions.

- Because of the binding of fertilizer, there is less fertilizer runoff, hence less destructive lake algae blooms.

- Agriculture with biochar produces less NOX's and other greenhouse gases than agriculture without it.

- Biochar may bind herbicides and pesticides, preventing them from entering crops.
- The disposal costs for farm and forestry refuse are reduced.
- Biochar binds water, reducing the water required in agriculture.
- USDA and other studies have shown that biochar enhances the quality of grown food.

It is possible for individual farmers to make biochar using simple equipment. Biochar production and use should be at a localized rather than large-scale effort. When distance is reduced, energy use and CO2 emissions from transportation are reduced, lowering cost. Indeed, biochar is best made in places like New England, where there is a mix of small farms and small forests in close proximity. To process certain byproducts into liquid fuels or intermediates for such things as plastics and pharmaceuticals, biochar must be made at a regional or semi-industrial level.

Two limitations in producing biochar must be observed: 1) the emitted CO2 from producing it from the agricultural and forest biomass for a given year and region must not exceed the uptake of CO2 by the crops and forest in that year and region 2) any biomass gathered must be free of toxic chemicals.

Further study of the economics of biochar is needed and is now underway, for example, at Cornell University, at the NE Small Farm Institute in Belchertown, MA, and in cooperative work with the Department of Plant, Soil, and Insect Sciences at UMass Amherst. Even more extensive studies are in progress abroad, particularly in Japan and Australia. It is premature to scale operations to industrial levels now. Studies underway will determine the size of operations that makes best economic and environmental sense.

Biochar combats climate change and lessens our energy needs as we replace shrinking world oil supplies with alternative energy (world oil production is now at a peak). Biochar creates local green jobs. It is not a “silver bullet” that will solve all our climate and energy problems, but it would be judicious for the Commonwealth to promote the R&D in biochar, which can be an important contribution to our environmental stewardship and energy independence.

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